# IGCSE Biology 0610 (2026-2028) Revision Notes: Topic 19 Organisms and their Environment

These notes are structured to cover all learning objectives for Topic 19: Organisms and their Environment in the Cambridge IGCSE Biology 0610 syllabus for examinations from 2026 to 2028.

---

## 19.1 Energy Flow

The **Sun** is the principal source of energy input to all biological systems.

### Flow of Energy

Energy flows through living organisms in the following way:

1. **Light Energy** from the Sun is absorbed by **producers** (plants and algae).
2. Producers convert light energy into **chemical energy** (in the form of organic molecules like glucose) via **photosynthesis**.
3. This chemical energy is transferred to **consumers** when they feed on other organisms.
4. At every stage (producer, consumer), a large amount of energy is **lost** to the environment as **heat** during **respiration**, or through waste products (faeces, urine).
5. Eventually, all energy is transferred to the environment as heat.

---

## 19.2 Food Chains and Food Webs

### Definitions

| Term | Definition |
| --- | --- |
| **Food Chain** | Shows the transfer of energy from one organism to the next, beginning with a **producer**. |
| **Food Web** | A network of **interconnected food chains** showing the feeding relationships in an ecosystem. |
| **Producer** | An organism that makes its own organic nutrients, usually by **photosynthesis**. |
| **Consumer** | An organism that gains energy by feeding on other organisms. |
| **Herbivore** | An animal that eats **plants** (primary consumer). |
| **Carnivore** | An animal that eats **other animals** (secondary, tertiary, or quaternary consumer). |
| **Decomposer** | An organism (e.g., bacteria, fungi) that feeds on **dead or waste organic material** (e.g., faeces) and breaks it down. |

## Trophic Levels

A **trophic level** is the position of an organism in a food chain, food web, or pyramid.

| Trophic Level | Organism Type | Example |
| --- | --- | --- |
| **Trophic Level 1** | **Producers** | Grass |
| **Trophic Level 2** | **Primary Consumers** (Herbivores) | Grasshopper |
| **Trophic Level 3** | **Secondary Consumers** (Carnivores/Omnivores) | Frog |
| **Trophic Level 4** | **Tertiary Consumers** (Carnivores/Omnivores) | Snake |
| **Trophic Level 5** | **Quaternary Consumers** (Top Carnivores) | Eagle |

## Pyramids

Pyramids are used to represent the flow of energy or the number/mass of organisms at each trophic level.

| Pyramid Type | What it Measures | Advantage/Disadvantage |
|---|---|---|
| **Pyramid of Numbers** | The number of individual organisms at each trophic level. | **Disadvantage:** Can sometimes be inverted or oddly shaped (e.g., one large tree supporting many insects). |
| **Pyramid of Biomass** | The total mass of living material (biomass) at each trophic level. | **Advantage:** Shows the actual amount of living tissue. Usually a true pyramid shape. |
| **Pyramid of Energy** | The amount of energy transferred to each trophic level over a period of time. | **Advantage:** Always a true pyramid shape, as energy is lost at each level. **Preferred** over numbers or biomass as it represents the energy flow more accurately. |

## Energy Transfer

Energy transfer between trophic levels is **inefficient**, with only about **10%** of the energy from one level being transferred to the next.

**Reasons for Energy Loss (90%):**

1. **Not all of the organism is eaten** (e.g., roots, bones, shells).
2. **Energy is lost in waste products** (faeces, urine).
3. **Energy is lost as heat** during **respiration** for movement, growth, and maintaining body temperature.

Because of this large energy loss, food chains usually have **fewer than five trophic levels**, as there is not enough energy remaining to support a higher trophic level.

**Energy Efficiency and Humans:** It is more energy efficient for humans to eat **crops directly** (primary consumer level) rather than **livestock fed on crops** (secondary consumer level). This is because a significant amount of energy is lost when the crop is fed to the animal.

# 19.3 Nutrient Cycles

## The Carbon Cycle

The carbon cycle describes how carbon is recycled between living organisms and the environment.

**Processes Involved:**

- **Photosynthesis:** Producers (plants) remove $CO_2$ from the atmosphere to make organic molecules (glucose).
- **Feeding:** Carbon compounds are transferred to consumers when they eat producers.
- **Respiration:** All living organisms (producers, consumers, decomposers) release $CO_2$ into the atmosphere as they break down organic molecules for energy.
- **Decomposition:** Decomposers break down dead organisms and waste products, releasing $CO_2$ via respiration.
- **Fossil Fuel Formation:** Carbon from dead organisms is converted into fossil fuels (coal, oil, gas) over millions of years under heat and pressure.
- **Combustion:** Burning of fossil fuels and wood releases $CO_2$ into the atmosphere.

## The Nitrogen Cycle

The nitrogen cycle describes how nitrogen is recycled between living organisms and the environment. Nitrogen is essential for making **amino acids** and **proteins**.

**Processes and Microorganisms Involved:**

1. **Nitrogen Fixation:**
    - **Lightning:** Converts atmospheric nitrogen gas ($N_2$) into nitrates ($NO_3^-$).
    - **Nitrogen-fixing bacteria** (found in soil or in the root nodules of legumes) convert $N_2$ into ammonium ions ($NH_4^+$).
2. **Decomposition (Ammonification):**
    - Decomposers break down dead organisms and waste products, converting the nitrogen in proteins and urea into **ammonium ions** ($NH_4^+$).
3. **Nitrification:**
    - **Nitrifying bacteria** convert ammonium ions ($NH_4^+$) into nitrites ($NO_2^-$), and then into **nitrates** ($NO_3^-$).
4. **Absorption (Assimilation):**

- Plants absorb **nitrates** ($NO_3^-$) from the soil and use them to make amino acids and proteins.
- These are transferred to animals through **feeding**.

5. **Denitrification:**
   - **Denitrifying bacteria** in waterlogged or anaerobic soil convert nitrates ($NO_3^-$) back into atmospheric nitrogen gas ($N_2$), completing the cycle.

---

# 19.4 Populations

## Definitions

| Term | Definition |
| --- | --- |
| **Population** | A group of organisms of **one species** living in the same area at the same time. |
| **Community** | **All the populations** of different species living in the same area at the same time. |
| **Ecosystem** | The **community of organisms** and their **non-living (abiotic) environment** interacting together. |

## Factors Affecting Population Growth

Population size is controlled by **limiting factors**, which include:

- **Food Supply:** Lack of food will limit growth.
- **Competition:** Organisms compete for resources (food, water, light, mates, territory).
- **Predation:** The number of predators and prey affects both populations.
- **Disease:** Infectious diseases can rapidly reduce a population size.

## Sigmoid Population Growth Curve

The **sigmoid (S-shaped) curve** shows the typical growth of a population in an environment with limited resources.

| Phase | Description | Explanation (Limiting Factors) |
|---|---|---|
| **Lag Phase** | Slow initial growth. | Few individuals, organisms are adjusting to the new environment, and the rate of reproduction is low. |
| **Exponential (Log) Phase** | Rapid growth. | Resources (food, space) are **plentiful**, and the rate of reproduction is higher than the rate of death. |
| **Stationary Phase** | Population size is constant. | The population has reached the **carrying capacity** of the environment. Limiting factors (e.g., lack of food, increased competition, waste accumulation) cause the rate of reproduction to equal the rate of death. |
| **Death Phase** | Population size decreases. | Limiting factors become severe (e.g., resources are exhausted, high levels of waste/disease), and the rate of death exceeds the rate of reproduction. |

---

*Notes compiled by Manus AI, based on the Cambridge IGCSE Biology 0610 Syllabus (2026-2028).*

## References

[1] Cambridge International Education. (2023). *Cambridge IGCSE Biology (0610) Syllabus for examination in 2026, 2027 and 2028*. Retrieved from https://www.cambridgeinternational.org/Images/697203-2026-2028-syllabus.pdf